

Severe local hail and wind storms, May, 1924—Continued

Place	Date	Time	Width of path (yards) ¹	Loss of life	Value of property destroyed	Character of storm	Remarks	Authority
Fort Smith, Ark.....	27	P. m.....			50,000-75,000	High wind.....	Heavy property damage. Fort Smith Light and Traction Company probably heaviest losers.	Official U. S. Weather Bureau.
Watts, Okla.....	27	7 p. m.....	2-3 mi.			Heavy hail.....	Considerable property damage.....	Do.
Do.....	28	7 p. m.....	2-3 mi.			do.....	do.....	Do.
Wetumka to Warner, Okla.....	28	5:30-6:15 p. m.....	133-1,760	9	190,000	Tornado.....	Heavy property damage; 37 persons injured.....	Do.
Stigler, Okla., to Fort Smith, Ark.....	28	7 p. m.....	300-150..	5	91,000	do.....	Heavy property and crop damage; 15 houses at Gans wrecked; 27 persons injured.	Do.
Meeker to Davenport, Okla.....	28	4:30 p. m.....	2 mi.....		20,000	Hail.....	Considerable damage.....	Do.
Dearing (near), Kans.....	28	6-8 p. m.....				do.....	Many wheat and oat fields devastated; roofs damaged and window panes broken.	Do.
Washington County, Ark.....	28	6:30 p. m.....				Tornado.....	Heaviest damage at Farmington; 7 houses demolished and orchards badly damaged.	Do.
Do.....	28	P. m.....			100,000	Hail and rain.....	Orchards, vineyards, and strawberries damaged. Storm followed tornado of same date.	Do.
Provo Bench, Utah County, Utah.....	29	7-7:10 p. m.....	2 mi.....		5,000	Moderate hail.....	Fruit and garden plants injured.....	Do.
Marinette, Ariz.....	30	6-7:30 a. m. or p. m.....				Heavy hail.....	1,000 acres of cotton damaged 25 per cent. Store unroofed by wind.	Do.

STORMS AND WEATHER WARNINGS

By EDWARD H. BOWIE, Supervising Forecaster

WASHINGTON FORECAST DISTRICT

The month as a whole may be characterized as a quiet one, there being few storms of consequence, and in all cases the warnings were confined to the middle and north Atlantic coasts.

The first display was made on the evening of the 3d, when southeast warnings were ordered from Sandy Hook to Eastport, in connection with a disturbance over eastern Ontario. Warnings were again disseminated on the evening of the 7th, from the Virginia Capes to Boston, due to the northward movement of a secondary that developed over the south Atlantic States. The storm continued its slow northward movement and warnings of strong winds, thick weather, and rains were issued on the evening of the 9th from Sandy Hook to Portland. Another secondary that developed over the south Atlantic coast and moved to southeastern Virginia required the issuance of northeast warnings from Delaware Breakwater to Eastport. The necessity for warnings did not occur again until the 18th, when a disturbance of marked intensity was central southeast of Hudson Bay. Southwest warnings were ordered on the morning of that day for the Atlantic coast from Delaware Breakwater to Eastport. Southwest storm warnings were again displayed on the morning of the 24th from the Virginia Capes to Eastport. Small-craft warnings were displayed at Mobile and Pensacola during the 26th.

Warnings of light frosts were required on a number of days for portions of the Ohio Valley, the lower Lake region, and the north and middle Atlantic States.

CHICAGO FORECAST DISTRICT

From the point of view of the forecaster, May, 1924, in the Chicago Forecast District was a month of decided activity. Frost warnings were issued for some part of the district on every day but the 16th, and likewise frost occurred in some part of the district every night except that of the 16-17th. Furthermore, the month was much stormier than usual on the Great Lakes, winds of storm force or within four miles thereof having occurred at some one or more Lake stations on 20 days.

Frost warnings.—At the opening of the month the growth of vegetation had advanced sufficiently to be injured by frost northward across Nebraska, Iowa,

southern Wisconsin, and Indiana. During the following two weeks the susceptible stage was reached over most of the remainder of the district, except the northern Lake region where frost warnings were not needed until about the close of the month. The dates on which the most general frost warnings were issued include the 6th to 10th, inclusive, 13th, 14th, 18th to 21st, inclusive, 23d to 25th, inclusive, and the 29th and 30th. The most damaging frost effects appear to have been those of the 11th in portions of Iowa, of the 19th and 20th in lower Michigan, and on several dates during the week ending on the 26th in North Dakota, Iowa, lower Michigan, and Indiana. Frosts were numerous in the Wisconsin cranberry bogs, and one observer described the month as a "terrible one."

Storm warnings.—There were three principal storm periods on the Great Lakes, namely, those of the 5-9th, 17-19th, and 23d-24th, all dates, inclusive. Altogether storm warnings were issued on nine days, and small-craft warnings on six additional days.

The first storm warning of the month was issued at 1 p. m. of the 5th for Lake Superior west of Marquette, northeast warnings being ordered. Noon special observations on that date had shown a disturbance of increasing intensity centered over the northern Plains, the lowest pressure being 29.48 inches. At the same time a high pressure area appeared in northern Manitoba, where the barometer read 30.24 inches. At 10 p. m. of the same date these warnings were extended over the Escanaba and Green Bay districts of Lake Michigan. By the morning of the 6th the disturbance was centered over Iowa with somewhat decreased energy, but verifying wind velocities had occurred during the night over most of the region where the warnings were displayed. Accordingly, small craft-warnings were issued for the remainder of the Great Lakes, and later, at 1 p. m., the warnings were continued on that portion of Lake Superior where already displayed. However, the latter were lowered at 10 p. m. As the disturbance moved slowly eastward it increased in intensity, so that it was necessary to issue northeast warnings on the night of the 7th for the northern portion of the Alpena District of Lake Huron. By the following morning the storm had still further increased in energy, and in connection with a high pressure area over Ontario had created a strong gradient across most of the Lake Region. As a result strong winds or moderate gales had set in over Lake Superior and the northern portions of Lakes Michigan and Huron. Therefore, the northeast warnings were extended over the remainder of the Great Lakes.

Twenty-four hours later, or on the morning of the 9th, a redevelopment of the storm had occurred over the Middle Mississippi Valley, and it was thus necessary to continue the warnings on Lakes Superior and Ontario, and on the northern portions of Lakes Michigan and Huron. At the same time small-craft warnings were displayed on Lake Erie. The warnings were lowered at 1 p. m. on Lake Ontario and at 9 p. m. elsewhere, as the storm lost energy rapidly after the morning of the 9th.

On the night of the 11th an advisory message was sent to all Lower Lakes stations relative to a disturbance then centered in southeastern Virginia and moving due north. By the following morning the center was near the District of Columbia, and the wind had reached moderate gale force at Cleveland, Ohio. Therefore, northeast warnings were issued for the Lower Lakes, except that the direction was made northwest west of Cleveland. The warnings were lowered at 9:30 p. m., the regular p. m. reports having showed that the storm was losing its force.

A northwest storm warning for Duluth, Minn., only, was issued at 2 p. m. of the 11th, the special observations indicating a disturbance over eastern Minnesota and a sharp gradient to the westward, with strong winds over North Dakota. It was necessary to continue this warning 24 hours later, owing to the fact that the disturbance had remained almost stationary during the 24 hours in question; at the same time the warnings were extended along the east shore of Lake Michigan. All warnings were lowered at 9:30 p. m., however, when it had become evident that the disturbance was losing energy.

On the morning of the 17th a rather deep low pressure area appeared north of Lake Superior, the lowest barometer being 29.32 inches. Thence southward to the Ohio River the gradient was marked. Accordingly, small-craft warnings were issued for Lakes Huron, Erie, and Ontario, but as developments showed, it would have been better to have displayed storm warnings. At points on Lakes Erie and Ontario verifying velocities were slightly exceeded. The disturbance was sluggish in its eastward progress, and small-craft warnings were again ordered on the morning of the 18th for the Lower Lakes, also for Lakes Superior and Huron. On this date moderate gales, and in some cases verifying velocities, occurred over portions of the Lakes in question.

The storm of the 23d-24th followed as a result of a general fall in pressure over the West during the two preceding days. On the morning of the 23d the disturbance existed as a trough extending from Lake Superior southwestward to Arizona, with the lowest pressure in southwestern Nebraska. At that time northwest warnings were issued for Lake Superior, and southwest warnings for Lakes Michigan, Huron, and Erie. In the afternoon the southwest warnings were extended over Lake Ontario. The disturbance moved northeastward with about normal velocity, but with an increase in energy. For the most part, the warnings issued in this connection were verified. On the night of the 23d the direction was changed to northwest on Lake Michigan, and likewise on Lakes Huron, Erie, and Ontario the following morning. Also, the northwest warnings were continued on Lake Superior east of Munising on the morning of the 24th. At 1 p. m. the warnings were lowered on Lake Michigan, southern Lake Huron, and Lake Erie west of Dunkirk, and at 9 p. m. on Lake Ontario, northern Lake Huron, and Lake Erie, from Dunkirk, N. Y., east. A redevelopment of this storm occurred on the night of the 24th-25th in the vicinity of Lake Superior, with the result that it was necessary to issue northwest warnings on the morning of the 25th for that Lake from Munising west, and also for

northern Lake Huron, as well as to continue the warnings on Lake Superior east of Munising. At the same time small craft warnings were issued for northeastern Lake Michigan, southern Lake Huron, and the Lower Lakes. At 9:30 p. m. the storm warnings were lowered. At Duluth, Minn., the wind reached a maximum velocity of 42 miles an hour on the 25th, and Alpena reported a maximum of 36 miles an hour on the following day.

Near the close of the month a disturbance from the Southwest threatened the southern Lake Region, especially the Lower Lakes, but it passed without causing winds of storm force. The only warning issued in this connection was that for small craft at Chicago.

The long range forecasts for the benefit of fruit interests in Door County, Wisconsin, were resumed during the month, and a similar service was begun for southwestern Michigan. Also, fire-weather forecasts were made for western Montana, the information being furnished to six Forest Supervisors.—*C. A. Donnel.*

NEW ORLEANS FORECAST DISTRICT

Small-craft warnings were displayed on the Texas Coast on the 6, 9, 10, 11, 15, 24, 26, and 28, and on the Louisiana Coast on the 29 and 30, for local thunder squalls. No general storm occurred on the Coast. Warnings for local thunderstorms were issued for Arkansas, Oklahoma, and eastern Texas on the 6; for Louisiana, Arkansas, and eastern Texas on the 27; Louisiana and East Texas on the 28; and Louisiana, eastern Texas and eastern Arkansas on the 29. Local thunderstorms occurred in the several States as forecast, and in a few localities the storms were severe.

Frost warnings were issued for the Texas Panhandle on the 7th, and for northern Oklahoma on the 15th.—*I. M. Cline.*

DENVER FORECAST DISTRICT

Low pressures prevailed on the Rocky Mountain Plateau during most of the period from the 1st to the 27th, with generally high pressures on the eastern slope and in the Plains States from the 6th to the 24th. There was little precipitation during the first two decades, and such occasional light showers as did occur were confined mostly to Colorado and extreme eastern New Mexico.

A low of considerable intensity that advanced from British Columbia to western Texas on the 24th, 25th, and 26th, together with a depression that remained over the extreme Southwest until the end of the month and a high that prevailed in the Northern Rocky Mountain States and the upper Missouri Valley after the 26th, was attended by showers in Colorado and Utah and occasionally in northern New Mexico from the 25th to the 30th, with snow in the mountains of Colorado. Heavy showers fell in Colorado and eastern and northern Utah from the 27th to the 29th and in northern New Mexico on the 30th. The temperature was much below normal in Colorado and Utah from the 26th to the 31st.

Frost warnings were issued as follows: 1st, frost in Colorado, extreme northern New Mexico, and the higher elevations of southern Utah; 5th, frost in the western valleys of Colorado, northern New Mexico, heavy frost in Utah, and freezing temperature at the higher elevations of southern Utah; 6th, heavy frost in Colorado and Utah, frost in northern New Mexico, freezing temperature at the higher elevations of Utah; 7th, frost in Colorado, northern New Mexico, and Utah; 8th, frost or freezing temperature in southwestern Colorado and frost in extreme northern New Mexico; 9th, frost or freezing

temperature in eastern and southern Colorado and frost in extreme northern New Mexico; 10th, frost in eastern Colorado and extreme northern New Mexico; 12th, frost in eastern Colorado; 13th, frost in northeastern Colorado; 14th, frost in southern and eastern Colorado and extreme northern New Mexico; 15th, frost in southern and extreme eastern Colorado and extreme northern New Mexico; 19th, frost in eastern Colorado; 24th, probably frost in northeastern Colorado; 29th, frost in northwestern Utah; 30th, frost in Colorado, if sky clears; 31st, frost in northern and western Colorado and southeastern Utah.

These warnings were generally verified by the occurrence of frost or by the ensuing temperature conditions.

No other warnings were issued or required during the month.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT

A moderate storm moved southward over the Rocky Mountain region during the first few days of the month and gave light but general rain in the north Pacific States on the 4th, but with this exception only a few scattered showers occurred in this district.

After the first few days the weather became very warm in all portions of this district and continued so throughout the month. This, in conjunction with the prevailing drought caused a condition that was extremely favorable for forest and grain fires, and fire-weather warnings were issued as follows: In northern California on the 5th, and thereafter precautionary warnings were broadcast by radio. On the 22d special daily warnings were commenced to Forest Service stations in Idaho.

It is pleasing to note in connection with the distribution of these warnings that the General Electric Co. in Oakland, Calif., and the Examiner in San Francisco, Calif., are cooperating with this office by broadcasting all warnings by radio, the General Electric broadcasting about noon and the Examiner about 7 p. m.—*G. H. Willson.*

627.41 (73) RIVERS AND FLOODS

By H. C. FRANKENFIELD, Meteorologist

Rains were frequent and occasionally heavy during the month of May over the territory east of the Mississippi River, and as a result floods were numerous, although not of serious character, except over the drainage area of the Potomac River. The floods were most prevalent during the second decade of the month and details regarding all will be found in the table at the end of this report. Lack of space forbids a more extended report.

The Potomac flood occurred from May 12 to 15, and was most severe in the Shenandoah River and in the Potomac from Harpers Ferry, W. Va., to Washington, D. C. Above Harpers Ferry the flood proportions were much less than in March, 1924, although the streets of Cumberland, Md., were again covered with water, with resulting damage of about \$35,000. From Harpers Ferry to Washington and in the Shenandoah River the flood was the severest since the memorable flood of June 1 and 2, 1889, and the damage amounted to about \$1,000,000.

The principal street of Harpers Ferry was under water to a depth of 6 feet at the lowest place, and just above Washington the banks of the Chesapeake & Ohio Canal were washed out for a considerable distance.

When the large area covered by the flood waters is considered, it will be seen that the losses were relatively small. In South Carolina the rivers had been above the

flood stage for so long that livestock could not graze in the lowlands, and but little planting had been done. Elsewhere the most serious aspect was the delay in farming operations.

The flood in the Arkansas River began about April 29 in the vicinity of Wichita, Kans., and extended only to a short distance below Fort Smith, Ark.

Floods in the rivers of Texas and in the Colorado River of Arizona were moderate. Along the Rio Grande in the State of New Mexico conditions were more critical, but fortunately the flood waters passed off without damage of consequence.

As the deficiency in snowfall during the last winter had indicated, the annual rise in the Columbia was very moderate, with no flood stages except at a very few points. Even at these the crest stages were only slightly above the flood stage.

Losses for the month as reported aggregated \$1,118,500, of which about \$1,000,000 occurred in the Potomac River drainage area. Direct crop losses were not large (only \$36,000 reported) but the indirect losses due to delayed farm operations must have been very heavy. About 4,000 acres of farm lands were submerged in the Evansville, Ind., district, 3,000 acres in the Fort Smith, Ark., district, and about 500 acres along the upper Trinity River of Texas.

The value of property saved through the Weather Bureau warnings was \$121,800, not including an estimate of several hundred thousand dollars in Pittsburgh, Pa.

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC DRAINAGE					
Connecticut:	<i>Feet</i>			<i>Feet</i>	
White River Junction, Vt.....	15	2	6	16.9	2
Potomac:					
Cumberland, Md.....	8	12	12	13.8	12
Harpers Ferry, W. Va.....	18	9	9	19.0	9
		12	14	27.6	13
Washington, D. C.....	8	13	14	12.1	14
Shenandoah:					
Riverton, Va.....	22	12	13	34.0	12
James:					
Buchanan, Va.....	15	12	13	19.1	13
Columbia, Va.....	18	12	14	31.5	12
Richmond, Va.....	10	13	15	21.0	14
Roanoke:					
Randolph, Va.....	21	12	13	21.7	13
Weldon, N. C.....	30	13	15	38.4	13
		22	23	32.5	22
Tar:					
Rocky Mount, N. C.....	9	16	16	9.0	16
Tarboro, N. C.....	18	18	18	18.0	18
Greenville, N. C.....	14	19	20	14.2	20
Neuse:					
Neuse, N. C.....	15	14	15	15.4	14
Smithfield, N. C.....	14	16	17	14.5	16
Santee:					
Rimini, S. C.....	12	1	11	13.4	4-5
		17	18	12.3	18
		30	31	12.3	31
Ferguson, S. C.....	12	(1)	12	13.2	6
		18	19	12.1	18
Saluda:					
Pelzer, S. C.....	7	(1)	(1)	7.0	Apr. 30
Chappells, S. C.....	14	2	2	14.4	2
EAST GULF DRAINAGE					
Coosa:					
Lock No. 4, Lincoln, Ala.....	17	28	29	18.0	28
Black Warrior:					
Lock No. 10, Tuscaloosa, Ala.....	46	29	30	50.7	29
Pearl:					
Jackson, Miss.....	20	(1)	(1)		
MISSISSIPPI DRAINAGE					
Stony Creek:					
Johnstown, Pa.....	10	9	9	11.0	9
		12	12	13.5	12
Kiskiminetas:					
Saltsburg, Pa.....	8	9	9	8.0	9
		12	13	11.0	12

¹ Continued from last month.

² Below flood stage 8 a. m. May 1.